



## PALEONTOLOGICAL TOURISM IN BRASIL: EXAMPLES AND DISCUSSION <sup>1</sup>

(With 9 figures)

ISMAR SOUZA DE CARVALHO <sup>2</sup>  
ÁTILA AUGUSTO STOCK DA-ROSA <sup>3</sup>

**ABSTRACT:** The paleontological tourism in Brazil is still at the beginning. Several fossiliferous sites were already transformed into parks or routes, but the main visiting targets are the museums. A broad perspective of interesting paleontological sites is provided here, as well as a discussion on the implementation of such tourism, in the need of an integrated project (scientific, social, economic, cultural, educational, and protective).

**Key words:** Paleontological tourism. Ecotourism. Scientific tourism. Education. Preservation.

**RESUMO:** O turismo paleontológico no Brasil: exemplos e discussão.

O turismo paleontológico no Brasil está ainda em fase inicial. Vários sítios fossilíferos já foram transformados em parques ou rotas, mas os principais alvos de visitação são os museus. Uma ampla perspectiva de sítios paleontológicos importantes é fornecida aqui, assim como uma discussão sobre a implementação deste tipo de turismo, com a necessidade de um projeto integrado (científico, social, econômico, cultural, educacional e preservacionista).

**Palavras-chave:** Turismo paleontológico. Ecoturismo. Turismo científico. Educação. Preservação.

### INTRODUCTION

Paleontology is a science that attracts so many people attention, through the discovery of new fossils, behavior aspects, or the identification of new species. It is an important area of the Geosciences, easy to understand and highly educative, which supports cultural tourism around the world, mainly connected with the knowledge of the pre-history. In this case, an important industry is responsible for the creation of movie and TV pictures, books, documentaries, souvenirs, food, clothes, temporary and permanent exhibits, congresses and symposia, and scientific tourism.

Paleontological tourism is a specific type of scientific tourism or ecotourism, related to the history of life on earth. It is performed in museums, parks, trails, routes, and in guided excavations (DA ROSA, this volume), as a link between preservation of the paleontological patrimony and regional socioeconomic development (SCHWANKE & SILVA, 2004).

Thus, preservation of the paleontological patrimony is important in distinct ways: scientific, cultural and economic. In scientific terms, it is fundamental in the approach of the biologic and ecologic evolution

on Earth, as well as on the analysis of the environmental changes of our planet, both past and present. In a legal approach, preservation of the paleontological patrimony is justified (WILD, 1988), as fossils are “cultural monuments”, of scientific importance and interesting for the global society.

The interdisciplinary approach of Paleontology with other sciences such as Biology, Physics, Genetics, Geology, Mathematics, Chemistry, and many others, provided a new vision of its importance and application. The use of fossils in research institutes and resources exploration (oil, gas, coal) brings more comfort to the world, extremely based on thermal energy for industrial and residential use; classic and molecular paleontology, seeking the parent affinities of living and extant species, and the reconstitution of vanished species, turn Paleontology into a dynamic science, with profound theoretical and applied interest.

In Brazil, the paleontological science goes back nearly two centuries ago. Its history is marked by several relevant scientific discoveries, based on important collections housed at museums or research and graduation institutes. However, this patrimony has been continuingly threatened by the predatory and organized action of great international museums or

<sup>1</sup> Submitted on September 14, 2006. Accepted on November 28, 2007.

<sup>2</sup> Departamento de Geologia, Instituto de Geociências, Universidade Federal do Rio de Janeiro, Cidade Universitária, Ilha do Fundão, 21949-900, Rio de Janeiro, RJ, Brasil, E-mail: ismar@geologia.ufrj.br.

<sup>3</sup> Laboratório de Estratigrafia e Paleobiologia, Departamento de Geociências, Universidade Federal de Santa Maria, Av. Roraima, s/n, Prédio 17, Campus Camobi, 97105-900, Santa Maria, RS, Brasil. E-mail: atila@smail.ufsm.br.

private collectors. Despite a specific legislation on fossils preservation, they perform an institutional procedure of illegal dealing of the scientific material. Preservation of this cultural legacy, important for both the Brazilian nation and the mankind as a whole, is certainly the great challenge of Paleontology in Brazil, now and in the future (CARMO & CARVALHO, 2004).

## MATERIAL AND METHODS

To discuss on the Brazilian fossiliferous patrimony, a summary of the fossiliferous sites and associated museums detailed by CARMO & CARVALHO (2004) were addressed here; for a further description, refer to those authors. More museums may be reached in the homepage of the Paleontological Brazilian Society <www.sbpbrasil.org>.

## RESULTS

### PRESERVATION OF THE FOSSILIFEROUS PATRIMONY AND ITS USE BY LOCAL COMMUNITIES

Preservation of the fossiliferous patrimony at Brazil is generally too complex. Although society recognizes the cultural importance of the fossiliferous sites and its fossils, predation and unauthorized excavations still occur. In the other hand, mining activities performed in sedimentary rocks have an important economic impact on local communities, where those fossiliferous sites are being used for economic transformation, and thus constraining the adoption of more efficient strategies for the paleontological tourism and preservation.

Preservation, evaluation, and consolidation of the fossiliferous sites as cultural elements, vital for the development of regional economic activities (through the scientific tourism), are necessarily linked to educational actions and legal responsabilization. The educational institutions (from fundamental education to university) are responsible for the social and community consciousness of the importance of our natural patrimony, and the urgent need for its preservation. The government (national, regional and local) is in charge for the inspection and on the assurance that the public patrimony will be properly guarded and used.

A restrictive law, prohibiting the commerce of fossils, goes back to March 4<sup>th</sup>, 1942 (Decreto-Lei n. 4,146); however, there are many cases of commerce and depredation of our fossiliferous sites (see examples in CARMO & CARVALHO, 2004). The Araripe Basin

(“Chapada do Araripe”) is certainly the most brutal one, due to an inefficient inspection, the low life conditions of local population, and an organized system of national and illegal dealing. Protection of the fossiliferous sites is not only a legal problem, but also an educational issue.

The paleontological societies around the world are now in the search of different manners to avoid the commerce of fossils, through specific laws, as well as avoiding the publication of papers based on private collections. Nevertheless, the population living near the fossiliferous sites may also act in their protection, with projects of patrimonial education (SCHWANKE & SILVA, 2004).

### THE PALEONTOLOGICAL PATRIMONY AND THE SCIENTIFIC TOURISM

Fossiliferous sites must be regarded as “natural cultural monuments”, due to their scientific importance and public interest. They represent unique moments of geologic history of our planet, helping to understand past and present ecologic and environmental changes, both catastrophic or not, the evolution of living beings and the meaning of life in our planet. That is the main fascination produced by Paleontology. A growing interest on this science comes from this perception of life, and how extemporaneous our existence can be.

Some of the fossiliferous localities in Brazil show both an exceptional preservation of its fossils and a basic infrastructure (access, lodging, guided tours), and thus an excellent potential for the paleontological tourism (Fig.1; Tab.1; CARMO & CARVALHO, 2004). Associations with regional museums, in which the local fauna and flora can be viewed, are extremely relevant for the outcome of paleontological tourism. The fossiliferous sites and associated museums detailed by CARMO & CARVALHO (2004) are the following:

#### A. The Permian Petrified Forest from Central Brazil

Located among the states of Tocantins, Maranhão and Piauí, the great Petrified Forest from Central Brazil includes trunks and ferns of pteridophytes, silicified or preserved as impressions. The genus *Psaronius* is the most important, but many specimens are not formally described yet. Specimens are very well preserved, mainly by histometabasis (Fig.2), in outcrops from the Pedra de Fogo Formation, Parnaíba Basin.

There is no local museum, and the area was ‘mistakenly’ mined. It is considered one of the greatest outcrops from the Permian flora of South America.



Fig. 1- Location of selected fossiliferous sites in Brazil, in which paleontological tourism already occurs, or is in preparation (letters refer to the text). For a more complete map of the Brazilian paleontological museums and research centers, see the Brazilian Geological Survey website, at <<http://www.cprm.gov.br/bases/novapale/paleind.php>>.

## B. The Paleontological Route

At the central region of the State of Rio Grande do Sul (Paraná Basin, Santa Maria and Caturrita formations), a Triassic fauna and flora composes the Paleontological Route, arranged in museums and guided visits to fossiliferous outcrops. Visiting comprehends the 'Petrified Forest from Mata' (MINELLO, 1995) and the 'Fossil vertebrates from Santa Maria region' (SCHULTZ, 1995) (Fig.3). A more in-depth description is provided elsewhere (DA ROSA, this volume).

## C. Cretaceous Dinosaurs, from Uberaba and Monte Alto

A good example of the importance of the fossiliferous patrimony on the modification of the local budget comes from Peirópolis, Municipality of Uberaba, State of Minas Gerais, an important fossiliferous site. The Municipality of Uberaba created the "Centro de Pesquisas Paleontológicas Lewellyn Ivor Price" (CPPLIP), at the district of Peirópolis, in a very innovative and visionary way. Since the 1980's, Peirópolis was an economically decadent place, due to the abandonment of the railroad and despite the mining activities on the area. As many industrial activities in Brazil, mining reverted a very few social and economic benefits to the local population. Deactivation of the nearby quarry could have turned

life difficult, but the creation of the CPPLIP helped to improve local economy, by creating new jobs, increasing property values and promoting a more distributed budget. The abandoned rail station was transformed into a research lab and preparation room, which supports an exhibit (Fig.4).

The 'Museu de Paleontologia de Monte Alto' (Fig.4; <<http://www.montealto.sp.gov.br>>) is located at the homonymous city, in the State of São Paulo (central portion of Bauru Basin). The mentor and present director is Prof. Antonio Celso de Arruda Campos, who gathered fossils of dinosaurs, crocodiles, turtles, bivalve mollusks, ichnofossils, and microfossils from the Upper Cretaceous. These fossils are both matter of university research and elements of educational activities with local students of fundamental and middle course teaching.

## D. 'Chapada do Araripe'

'Chapada do Araripe' is a flat-lying mountain developed over the Araripe Basin, a large Cretaceous intracratonic sedimentary basin. It is located at the limits of the states of Ceará and Pernambuco, northeastern Brazil. There are several fossiliferous sites, in which microfossils, ichnofossils, plants, vertebrates, and invertebrates can be found (CARVALHO, 2001; LIMA, 1978; NUENS, 1994; MAISEY, 1991).



TABLE 1. Brazilian paleontological sites protected and published by SIGEP till 2002 ([www.unb.br/ig/sigep/sitios.htm](http://www.unb.br/ig/sigep/sitios.htm) and SCHOBENHAUS *et al.*, 2002).

1. O Membro Crato da Formação Santana, Chapada do Araripe, CE - M. S. Sales Viana; V. H. L. Neumann	Crato Member of the Santana Formation, rich in animal and plant fossils – Paleontological
2. Sítios Paleobotânicos do Arenito Mata, Municípios de Mata e São Pedro do Sul, RS - M. Guerra-Sommer; C.M. S. Scherer	Triassic Petrified Forest – Paleontological
3. <i>Mesosaurus</i> da Serra do Caiapó-Montividiu, GO, e Passo de São Borja, RS - D. Araújo-Barberena; J. V. de Lacerda Filho; L. de L. Timm	Permian <i>Mesosaurus</i> – Paleontological
4. Pegadas de dinossauros das bacias Rio do Peixe, PB - G. Leonardi; I. de S. Carvalho	Early Cretaceous dinosaurs tracks, with the third longest world track (more than 20 m) – Paleontological
5. Caverna Aroe Jari ou das Almas, Chapada dos Guimarães, MT - L. B. de Almeida, M. I. C. Moreira	<i>Arthropycus</i> ichnofossils – Paleontological
6. O Sítio Fossilífero de Pirapozinho, Ramal dos Dourados, Pirapozinho, SP - J. M. Suarez	Bone bed of fossils turtles – Paleontological
7. Tufas Calcárias da Serra da Bodoquena - P.C. Boggiani; A. M. Coimbra; A. L. D. Gesicki; A. N. Sial; V. P. Ferreira; F. B. Ribeiro; J. -M. Flexor	Carbonate deposits with foliar imprints and Pleistocene mammals – Speleological and Paleobiological
8. Ilha de Fortaleza, PA - V. de A. Távora; A. C. S. Fernandes; C. S. Ferreira	Fossiliferous limestone of Pirabas Formation, Lower Miocene – Paleontological
9. Fazenda Arrecife, Chapada Diamantina, Morro do Chapéu, BA - N. K. Srivastava; A. J. D. Rocha	Exposures of Neoproterozoic stromatolites – Paleontological and Stratigraphic
10. Sítio Jaguariaíva, PR – R. T. Bolzon; I. Azevedo; M. L. Assine	Fossiliferous area of Devonian rocks – Paleontological
11. Toca da Janela da Barra do Antonião, São Raimundo Nonato, PI - C. Guerin; M. Faure; P. R. Simões; M. Hugueney; C. Mourer-Chauvire	Parque Nacional da Serra da Capivara: Pleistocene megafauna – Paleontological and Speleological
12. Jazigo icnofossilífero de Ouro, Araraquara, SP - G. Leonardi; I. S. Carvalho	Ichnofossiliferous sandstones, with vertebrate tracks (mammals and dinosaurs) – Paleontological
13. Afloramento Bainha, Criciúma, SC - R. Iannuzzi	Permian <i>Glossopteris-Gangamopteris</i> Flora – Paleontological
14. Fazenda Cristal, Morro do Chapéu, BA - N. K. Srivastava; A. J. D. Rocha	Mesoproterozoic stromatolitic bioherms – Paleoenvironmental, Stratigraphic and Paleontological
15. Fonseca, MG - C. L. Mello; L. G. Sant'Anna; L. Paglarelli Bergqvist	Tertiary plant fossils – Paleontological
16. Tetrápodes triássicos, RS - M. C. Barberena, C. L. Schultz, C. M. S. Scherer & M. Holz	World famous reptiles, cradle of the dinosaurs and mammals – Paleontological
17. Jazigo rodovia Quiririm-Campos do Jordão, km 11 (Tremembé), SP - M.E.C. Bernardes-de-Oliveira, A. F. M. de Lacerda, M. J. Garcia & C. C. Campos	Tertiary plant macrofossils – Paleontological
18. Fazenda Santa Fé (Tremembé), SP - M. E. C. Bernardes-de-Oliveira, A. F. M. Lacerda, M. J. Garcia & C. C. Campos	Brazilian biggest association of Tertiary fossils – Paleontological
19. Membro Romualdo da Formação Santana, Chapada do Araripe, CE - A. W. Kellner	Cretaceous fossiliferous carbonate concretions – Paleontological



Fig.2- The Great Petrified Forest from Central Brazil: a) outcrops of the Pedra de Fogo Formation (Parnaíba Basin); b) permineralized log (*Psaronius* sp.).



Fig.3- The Paleontological Route, at southern Brazil: a) 'Museu Guido Borgomanero' at Mata; b) 'Museu de Ciência e Tecnologia - PUCRS', at Porto Alegre.

In order to avoid depredation and illicit fossil commerce (FERNANDES & CARVALHO, 2000), several museums now exist:

'Museu de Paleontologia da Universidade Regional do Cariri', at Santana do Cariri (Fig.5), is constituted by permanent and temporary exhibits, library, TV and video room, and a research area. The museum was founded by Prof. Plácido Cidade Nuvens, when he was the University Rector, and contains more than 3,000 specimens, such as silicified logs, coniferophyt imprints, flowering plants, mollusks, arthropods, fish, amphibians, and reptiles. Very delicate anatomic structures were preserved, like insects bristles and vertebrate muscle remains;

'Museu de Ciências Naturais e de História Barra do Jardim', at Jardim, is maintained by the 'Fundação Francisco de Lima Botelho', which works on citizenship development through an educational

program. The museum houses arthropods, fish, reptiles and conifers from the Araripe Basin;

'Museu dos Fósseis - Centro de Pesquisas Paleontológicas da Chapada do Araripe' (CPPCA), at Crato, is supported by the federal mining agency 'Departamento Nacional da Produção Mineral' (10th District, Ceará). The exhibit presents insects, crustaceans, mollusks, permineralized logs, foliar imprints of different plant groups, fish, reptiles, and specimens from the Pleistocene megafauna. CPPCA was created as an effort to establish a research center, performing educational activities and helping to protect the fossiliferous patrimony. Its paleontological collection partially comes from the apprehension of smuggled specimens, which unfortunately is the exception, as there is few material and human resources to protect all the area.





Fig.4- Cretaceous dinosaurs, at southeastern Brazil: a) 'Museu de Paleontologia' at Monte Alto, São Paulo; b) 'Museu dos Dinossauros', at the 'Centro de Pesquisa Paleontológica Lewellyn Ivor Price', at Peirópolis, Uberaba.



Fig.5- 'Chapada do Araripe', at northeastern Brazil: a) outcrops of the Crato Member (Santana Formation, Araripe Basin; b) 'Museu de Paleontologia', at Santana do Cariri; c) well preserved insects.

#### E. 'Museu do Homem Americano'

Located at São Raimundo Nonato (State of Piauí), it gathers prehistoric information from the 'Parque Nacional Serra da Capivara', which turned to be the most important paleontological collection of northeastern Pleistocene megafauna. Fossils in exhibition are *Palaeolama*, *Hippidion*, *Eremotherium*, *Catonyx*, *Pampatherium*, *Glyptodon*, *Panochtus*, *Toxodon*, *Macrauchenia*, *Haplomastodon*, and *Smilodon* (MUSEU DO HOMEM AMERICANO, 1998), showing the region paleodiversity and climatic and environmental conditions in the past.

The 'Museu do Homem Americano' is maintained by the 'Fundação Museu do Homem Americano' (FUMDHAM), that is responsible for the scientific research and the preservation of the cultural and natural patrimony of the 'Parque Nacional Serra da Capivara'. Besides the museum, there is also a guided tour to the park, where the visitor receives information about the rock paintings, the cultural traditions of the pre-history, and the environmental context of the megafauna sites.

#### F. 'Museu de Ciências da Terra – Departamento Nacional da Produção Mineral'

It is a museum that received the paleontological collection and documents of the Brazilian mining agency 'Departamento Nacional da Produção Mineral'. Located at Rio de Janeiro, contains fossils, rocks, minerals and meteorites. The fossil specimens are more than 50,000, from many

sedimentary basins, and show the paleodiversity of our country, both fauna and flora. Many fossils are unique, and/or come from destructed or presently inaccessible outcrops.

#### G. 'Parque Vale dos Dinossauros'

Sousa and Uiraúna-Brejo das Freiras are Cretaceous sedimentary basins, with dinosaur tracks (CARVALHO, 1996; GODOY & LEONARDI, 1985; LEONARDI, 1979 a,b; LEONARDI, 1980). They are located at the region of Peixe River, west of the State of Paraíba, northeastern Brazil. The basins were originated during the opening of the Atlantic Ocean, due to transcurrent faults movement (CARVALHO, 2000; CARVALHO & LEONARDI, 1992).

The sedimentary basins have a rich dinosaurian and non-dinosaurian ichnofauna (LEONARDI & CARVALHO, 2002). The most important site is located at 'Passagem das Pedras', transformed into a park with guided tours, and a whole infrastructure for the preservation of the ichnofossiliferous site (Fig.6). Investments already exceeded US\$ 800,000.00, in the infrastructure detailed in CARMO & CARVALHO (2004): modification of the main course of the river, to protect the fossil levels; reforestation of native vegetation; road access to the park; steel bridges over the fossiliferous rocks; construction of a reception center. The park contains a permanent exhibit, TV and video room, library, souvenirs store, snack bar, restrooms and administration rooms, as well as reconstructed fossils outside.



Fig.6- 'Parque Vale dos Dinossauros' at Sousa, Paraíba: a) saurpoid track; b) steel bridge over dinosaur tracks; and c) reconstruction of theropod track-makers.



### I. Ilha do Cajual

The Cajual Island is located at the São Marcos bay, Municipality of Alcântara, State of Maranhão. It is an environmental protection area, with fossiliferous Cretaceous rocks. Fossils are more common near the 'Estação Ecológica da AMAVIDA', in a bone bed called 'Laje do Coringa' (MARTINS, 1996; MEDEIROS, 2001; MEDEIROS, 2003). MEDEIROS *et al.* (1996) recognized teeth and bones of dinosaurs, crocodiles, scales and bony plates of holostean fish, as well as huge tracheophyt logs. Thus, the State of Maranhão created the 'Centro de Pesquisa de História Natural e Arqueologia do Maranhão' (Fig.7), in which there is a paleontological and archeological research area.

### J. 'Parque Paleontológico São José de Itaboraí'

The paleontological park is located over Paleocene deposits of the São José de Itaboraí sedimentary basin, at the Municipality of Itaboraí, State of Rio de Janeiro. The area was formerly mined for cement production. According to MEDEIROS & BERGQVIST (1999), the limestone provided a rich fossil fauna and flora: fungi, pollens, angiosperms, gastropods, ostracods, amphibians (*Gymnophiona* and *Anura*), reptilians (chelonians, snakes, and crocodiles), birds and mammals (marsupials, *Condilarthra*, *Litopterna*, *Notoungulata*, *Astrapotheria*, *Xenungulata*, *Edentata*, and *Proboscidea*). The park

was created in 1995 and occupies an area of more than 1km<sup>2</sup>, being also used in studies of Landscape Archaeology (BELTRÃO *et al.*, 2001). In an effort to revitalize tourism at the park, the local community works with researchers and technicians in a working group to improve local activities and an educational program (RODRIGUES, 2005).

### K. Neogene Megafauna from the Amazonian Region

Several Neogene fossiliferous deposits can be found in Amazon, preserving the environmental, climatic and biotic shifts of the northern Brazil. In the State of Acre, many rivers present outcrops of the Solimões Formation (Upper Miocene – Pliocene), studied by the 'Laboratório de Pesquisas Paleontológicas da Universidade Federal do Acre'. A rich fauna is recorded: bivalves, gastropods, decapods, crocodilomorphs, chelonians, mammals, as well as permineralized logs (Fig.8, COSTA & ROSAS JR., 2001; MAIA & MAIA, 2001; MELO, 2001). The Juruá River also shows some Pleistocene deposits, in which crocodilomorphs and mammals were found (RAMOS & SOUZA FILHO, 2001), indicating a widespread distribution over the western Amazon (RANZI, 2001).

At Belém, the Museu Paraense Emílio Goeldi houses a collection concerning the main fossil groups found in the Northern Brazilian basins.



Fig.7- 'Cajual Island', at northern Brazil: external view (a) and exhibit room (b) of the 'Centro de Pesquisa de História Natural e Arqueologia do Maranhão', at São Luís –Maranhão.



### L. Pleistocene Megafauna from Minas Gerais and Bahia caves

The states of Minas Gerais and Bahia present many limestone caves, in which there is a broad record of Pleistocene mammals (see CARTELLE, 1994 for a detailed description). These caves are also important for the study of early occupation of South America, as the discovery of “Man from Lagoa Santa”, by the Danish paleontologist Peter Wilhelm Lund, on the XIX century, and present studies of “Luzia”, by the Brazilian anthropologist Walter Neves.

The Pleistocene fossils may be seen at: the ‘Museu de Ciências Naturais da Pontifícia Universidade Católica de Minas Gerais’, an important collection of the Pleistocene megafauna; the ‘Museu de História Natural da Universidade Federal de Minas Gerais’; and at the ‘Zoológico de Pedra’ (StoneZoo), located at Cordisburgo, State of Minas Gerais, in which concrete sculptures represent the megafauna (Fig.8).

### M. Paleontological Center of Mafra

Located at the city of Mafra, State of Santa Catarina, the Paleontological Center of Mafra (CENPALEO) was



Fig.8- The Megafauna: a) Neogene from western Amazon, a skull replica of the giant crocodile *Purussaurus brasiliensis*; b) Pleistocene from Minas Gerais, ‘Zoológico de Pedra’ (StoneZoo), at Cordisburgo; c) at the ‘Museu de Ciências Naturais da Pontifícia Universidade Católica de Minas Gerais’, which shows a diorama with a replica of the office of Peter Wilhelm Lund (d).

created at 2002, to house the collection of mesosaurs. It performs educational and research activities, as well as an integrated effort to protect the fossiliferous sites in the area (Fig.9)

#### N. Taubaté Natural History Museum

The Taubaté Natural History Museum is centered on a rich Cenozoic fauna from the Taubaté Basin, and also on fossil and present skeletons and taxidermized specimens. The main attraction is a complete specimen of the giant non-flying bird *Paraphysornis brasiliensis* (ALVARENGA, 1982, 1985a,b, 1990, 1993; ALVARENGA & HÖFLING, 2003). The museum performs research and educational activities, integrating the local community (Fig.9).

#### O. Geological Museum from Bahia

The Fossils Room of the Geological Museum from Bahia, among other attractions, exhibits a complete replica of the proboscidean *Haplomastodon waringi*, a common Pleistocene mammal exhumed from carbonatic caves. The museum is presently in the process of integrating research and educational activities.

#### P. Mineralogical Museum Professor Djalma Guimarães

Located downtown at Belo Horizonte (MG), the Mineralogical Museum is dedicated to the work of Professor Djalma Guimarães, a brilliant Brazilian geologist. There are fossils and replicas in the collection, mainly from the "Oficina das Réplicas – USP".

#### Q. Estação Ciência

The integration of the research, education, and leisure is very well established at this interactive museum. Born as an extension project of the Universidade de São Paulo, the Estação Ciência is a center of scientific, technologic and cultural diffusion, in which a mix of long term and itinerant exhibits are displayed next to shows, short courses, workshops, and cultural gatherings. Their main objective is centered on providing multiple and interdisciplinary educational resources to teachers and lecturers from school grades.

### DISCUSSION

The non-academic community must realize that fossils are part of the cultural, public patrimony, which may be important to the local economic reactivation and/or development, an increase on population self-esteem, as well as on helping to rescue regional cultural values and identity. In a world of globalization, the paleontological heritage comes to be the outmost benefit for the population.

The use of the fossiliferous sites and the fossils found there must be based on an educational program, fiercely attached to a strong legislation. In this case, fossil commerce and depredation may diminish, or even finish. However, the government (federal, regional and local) must always provide the means to protect and inspect the use of the paleontological patrimony.



Fig.9- Fossil exhibits at: a) 'Centro de Paleontologia de Mafra', state of Santa Catarina; b) the Natural History Museum of Taubaté, State of São Paulo.



Success in protecting the public patrimony is generally linked to activities that return knowledge and welfare to these communities. These simple, but long-lasting elements may also help in understanding the true meaning of Citizenship (CARVALHO *et al.*, 1999).

According to the World Tourism Organization (WORLD TOURISM ORGANIZATION, 2003), many tourist sites, including the paleontological parks, may not 'pay for themselves', in a first moment. In general, they are unable to guarantee a monetary influx greater than their construction, development, and operational costs. However, the influx of tourists and the widespread use of commercial services generally justify a huge money cost, on equipments and operation. Thus, there is an economic purpose, but not strictly financial.

As in any other commercial enterprise, financial return is not immediate. Also, the financial return volume is associated with how much money is invested first (Tab.2). So, as any kind of industry, there is no space for 'quick return'. The bigger is the investment for the construction, maintenance, and renovation of the tourist spaces and products; larger is the volume of visitors and a socio-economic return. To the local community, the financial quest may be the most interesting, but in a long term, the maintenance of the natural patrimony matters to the entire community.

In summary, the paleontological tourism in Brazil may be viewed as an alternative way of protecting the national paleontological patrimony, through visiting museums, parks and fossiliferous sites, in

an organized and educational way, for the visitor and the community around. This kind of cooperation among science, economics, and workfare generally allows a better-distributed welfare, a more disseminated knowledge and culture, and the formation of citizens that are engaged on the fossils protection.

## CONCLUSIONS

The Brazilian paleontological patrimony is incredibly rich and important, both in scientific and touristic terms. However, the use of fossils and fossiliferous sites without the participation of the local communities, integrated in educational activities, as well as an inefficient governmental inspection are the main causes for the destruction or illegal dealing of this worldwide legacy.

The paleontological tourism in Brazil is just beginning. So, it is extremely important that all the agents take extreme care on the implementation of parks and routes. In our point of view, only an integrated effort, joining researchers, technicians and the community, can prevent the destruction of the paleontological patrimony and improve the socio-economic-cultural development of the local population.

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TABLE 2. Examples of socio-economic return of four museums with paleontological exhibits in the State of Rio Grande do Sul.

	INITIAL INVESTMENT VOLUME	VISITORS (PER YEAR)	RAW ECONOMIC RETURN*
Museu Paleontológico Walter Ilha, São Pedro do Sul (Secr. Turismo, personal com.)	not informed	1,450	not informed
Museu Guido Borgomanero, Mata (Secr. Turismo, personal com.)	not informed	11,000	R\$ 20,000.00
Museu de Ciências Naturais – UCS, Caxias do Sul (P. Reginatto, personal com.)	not informed	60,000	not informed
Museu de Ciência e Tecnologia – PUCRS, Porto Alegre (J. Bertoletti, personal com.)	R\$ 10,000,000.00	100,000	R\$ 1,000,000.00

(\*) = Annual estimates.

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